IN THE SPECIFICATION:

Please replace paragraph [0001] with the following paragraph:

[0001] ~~The United States Government has rights in this invention pursuant to Contract No. W-7405-ENG-48 between the United States Department of Energy and the University of California for the operation of Lawrence Livermore National Laboratory.~~ The present invention relates to and claims priority under 35 USC 120 to Provisional Application No. 60/274200 filed March 8, 2001, entitled "Ceria-Based Solid Oxide Fuel Cells."

Please remove paragraph [0002] from under the heading title "Background" and place it directly under paragraph [0001]. Also, please replace the text of paragraph [0002] with the following text:

[0002] ~~The present invention relates to and claims priority under 35 USC 120 to Provisional Application No. 60/274200 filed March 8, 2001, entitled "Ceria-Based Solid Oxide Fuel Cells".~~ The United States Government has rights in this invention pursuant to Contract No. W-7405-ENG-48 between the United States Department of Energy and the University of California for the operation of Lawrence Livermore National Laboratory.

Please replace paragraph [0008] with the following paragraph:

[0008] The present invention provides a fuel cell structure that can achieve the power output of the above-referenced Siemens Westinghouse fuel cell (300mW/cm^2) at much lower operating temperature (below 600°C). An embodiment of a fuel cell of this invention includes an anode of NiO/doped-ceria, a thin film of doped-ceria and/or doped zirconia electrolyte, and a cathode of cobalt iron being deposited by colloidal spray deposition, described and claimed ~~ion U.S. Application Serial No. 09/293.446~~ in US patent No. 6,358,567 B2 filed April 16, 1999 entitled "Colloidal Spray Method for Low Cost Thin Coating Deposition", and assigned to the same assignee.

Please replace paragraph [0025] with the following paragraph:

[0025] As pointed out above, at least the doped-ceria is deposited by the colloidal spray deposition (CSD) technique of above-referenced ~~application 09/293,446~~ US patent No. 6,358,567 B2. The following sets forth a brief description of the CSD technique and apparatus for carrying out the technique.

IN THE CLAIMS

1. (Twice Amended) A solid oxide fuel cell ~~operating at a temperature in the range of 400-700°C~~, comprising~~:~~;

an anode including doped-ceria, wherein said doped-ceria is deposited by colloidal spray deposition;

an electrolyte including doped-ceria~~, based~~; and

a cathode including at least one cobalt iron based materials~~, whereby the~~ wherein said fuel cell is capable of operating ~~operates~~ in the temperature range of 400-700°C.

2. (Twice Amended) The fuel cell of Claim 1, wherein said anode ~~is composed of~~ comprises NiO and doped-ceria.

3. (Twice Amended) The fuel cell of Claim 1, wherein said doped-ceria ~~includes~~ is doped with at least one dopants selected from the group consisting of samarium oxide, gadolinium oxide, yttria oxide, and lanthanide oxide.

4. (Twice Amended) The fuel cell of Claim 1, wherein said anode, said electrolyte, and said cathode are porous. ~~fuel cell includes pores created by a pore former.~~

5. Cancelled

6. (Twice Amended) The fuel cell of Claim 1, wherein said electrolyte comprises material selected from the group consisting of doped-ceria, doped-zirconia with a thin layer of doped-ceria, and a mixture of doped-ceria and doped-zirconia.

7. (Twice Amended) The fuel cell of Claim 1, wherein said ~~electrode~~ cathode is selected from the group consisting of (La, Sr)(Co, Fe) O_3, and (La, Ca) (Co, Fe, Mn)O_3.

8-10. Cancelled

11. (Twice Amended) The fuel cell of Claim 1, wherein the cathode ~~of the fuel cell comprises material composed of~~ comprises a cobalt, iron, manganese based material. ~~formed by colloidal spray deposition.~~

12. (Currently amended) A ceria-based solid oxide fuel cell ~~including~~ comprising:

an anode containing doped-ceria, wherein said doped-ceria is deposited by colloidal spray deposition;

an electrolyte containing doped-ceria~~,~~;

an electrode containing cobalt iron based materials~~,~~; and

a fuel selected from the group consisting of hydrogen, methane, methanol, propane, butane and other hydrocarbons.

13. (Original) The fuel cell of Claim 12, operating in a temperature range of 400-700°C.

14. (Original) The fuel cell of Claim 12, wherein said fuel is composed of hydrogen or methane, and wherein the operating temperature is about 550°C.

15. (Twice Amended) The fuel cell of Claim 12, wherein said fuel is hydrogen, and said fuel cell has a power output of up to 400mW/cm^2 at an operating temperature of 550°C.

16. (Twice Amended) The fuel cell of Claim 12, wherein said fuel is methane, and said fuel cell has a power output of 320mW/cm^2 at an operating temperature of 500°C.

17. (Amended) The fuel cell of Claim 12, wherein said anode comprises NiO and doped-ceria.

18. (Original) The fuel cell of Claim 17, wherein said electrolyte additionally includes doped-zirconia.

19. (Amended) The fuel cell of Claim 18, wherein said electrode is ~~composed of (La, Sr)(Co, Fe) O_3~~ selected from the group consisting of (La, Sr) (Co, Fe)O_3 and (La, Ca) (Co, Fe, Mn) O_3.

20. (Original) The fuel cell of Claim 19, wherein said doped-ceria is doped with samarium oxide or gadolinium oxide.

Remarks

Support for the amendment to claims 1 and 12 can be found in Applicants' specification page 4, [0015]; page 5, [0024]; and page 6, [0025]. Support for the amendment to claims 3, 6, 7, and 11 can be found in Applicants' specification on page 5, [0023]. The amendments to claims 2, 4, 15, 16, and 19 were made for purposes of clarity. Applicants submit that no new matter has been added by the above-mentioned amendments to the specification and claims.

Objections to the specification

The specification has been amended in accordance with the Examiner's suggestions.

Rejections under 35 U.S.C. 103(a)

In the Office Action mailed March 6, 2003, the Examiner rejected claims 1-3, 6-9 and 12-17 under 35 U.S.C. 103(a) as being unpatentable over U.S. patent No. 5,350,641 (Mogensen) in view of EP 0 275 356 A (EP '356) and U.S. patent No. 5,937,264 (Wallin).

Under MPEP §2142, there are three requirements to establish a *prima facie* case of obviousness.

1) There must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the references or to combine reference teachings.
2) There must be a reasonable expectation of success.
3) The prior art reference (or references when combined) must teach or suggest all the claim limitations.

It should be noted that the teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

First, Applicants submit that the rejection fails under the first prong of the obviousness test because only through impermissible hindsight would motivation be found to combine the Morgensen, EP '356, and Wallin references. MPEP §2142 states "the tendency to resort to 'hindsight' based upon applicant's disclosure is often difficult to avoid due to the very nature of the examination process. However, impermissible hindsight must be avoided and the legal conclusion must be reached on the basis of the facts gleaned from the prior art." Also, under MPEP §2143.01, "[t]he mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination." *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990).

Applicants claim 1 recites, "A solid oxide fuel cell, comprising: an anode including doped-ceria, wherein said doped-ceria is deposited by colloidal spray deposition; an electrolyte including doped-ceria; and a cathode including at least one cobalt iron based materials, wherein said fuel cell is capable of operating in the temperature range of 400-700°C." Applicants claim 12 recites, "A ceria-based solid oxide fuel cell comprising: an anode containing doped-ceria, wherein said doped-ceria is deposited by colloidal spray deposition; an electrolyte containing doped-ceria; an electrode containing cobalt iron based materials; and a fuel selected from the group consisting of hydrogen, methane, methanol, propane, butane and other hydrocarbons."

The primary reference cited by the Examiner, i.e., Morgensen, only discloses the claim limitation "an anode including doped-ceria." The Examiner states on page 3 of the above-mentioned office action that "Mogensen discloses a solid oxide fuel cell (SOFC), comprising an anode including doped ceria, and electrolyte and a cathode (abstract and col. 3, line 9 through col. 4, line 4 as applied to claim 1)...The differences between the instant claims and Mogensen are that Mogensen does not teach of the electrolyte containing doped-ceria (claims 1 and 6) or of the cathode containing a cobalt iron based material (claim 1)..." Applicants respectfully submit that Morgensen discloses that "[t]he operating temperature of a stack of solid state cells is approximately 1000 °C." (See Morgensen col. 1, lines 14-15). The motivation for using a Ceria-based anode in Morgensen was to avoid the degradation of the Ni-YSZ anode of the prior art, which was caused by the reaction of the methane fuel with the nickel in the anode. CeO_2 is doped with a metal oxide ion smaller than Ce^{4+} to form the anode disclosed in Morgensen in order to allow methane to be used as the fuel source. (See Morgensen cols. 3 and 4.) Nowhere in Morgensen is there any suggestion of a desire to reduce the operating temperature of the fuel cell.

The Examiner states on page 4 of the March 6, 2003 Office Action that "EP '356 discloses that doped ceria electrolytes (CeO_2 doped with materials such as CaO or Gd_2O_3) compared to zirconia based electrolytes are preferable since the exhibit higher conductivity that the zirconia based electrolytes and can be operated at lower temperatures (page 3, ii. 42-45)." However, EP '356 also discloses that when using a CeO_2 doped electrolyte instead of a zirconia based electrolyte "[the fuel cell's] output will deteriorate disadvantageously." (See EP '356, page 3, lines 45-49.) Thus, Applicants submit that no motivation to modify

Morgensen reference can be found in the EP '356 reference because such a modification would be disadvantageous to the fuel cell's output, an undesirable result. Therefore, Applicants respectfully submit that the rejection under 35 U.S.C. 103 (a) should be withdrawn.

Neither Morgensen nor EP '356 discloses the use of at least one cobalt iron based material as claimed by Applicants. The Examiner states on page 5 of the March 6, 2003 Office Action that "[i]n particular when the ionically conductive material is ceria or doped ceria, Wallin teaches that the electrocatalyst in the electrode is preferably a cobalt iron based material..." Applicants submit that since Morgensen uses a YSZ electrolyte, not a ceria based ionically conductive material, no motivation exits in Wallin to modify Morgensen. Applicants respectfully submit that combining the Morgensen reference with EP '356 and Wallin would only be made through impermissible hindsight because there is no teaching or suggestion in any of the references to make the proposed modifications.

Second, Applicants respectfully suggest that the rejection fails under prong 3 of the obviousness test in that the references do not teach or suggest all the claim limitations. On page 3 of the March 6, 2003 Office Action, the Examiner states the following. "Note that the operating temperature of claim 1 does not further limit the SOFC fuel cell system. A claim containing a 'recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus' if the prior art apparatus teaches all the structural limitations of the claim."

Applicants respectfully disagree. The language added to claim 1 and claim 12, i.e., wherein said doped-ceria is deposited by colloidal spray deposition, imparts structural characteristics to the fuel cell that enable it to operate in the temperature range of 400-700 °C. As discussed, Morgensen discloses a fuel cell having a CeO_2-based ceramic as the anode that operates at 1000 °C. The fuel cell disclosed in Morgensen can not operate efficiently at lower temperatures. Applicants' specification states that "the fuel cell of this invention has a power output at 500 °C which is 10 times that of currently known fuel cells operating at that temperature," (see Applicants specification page 9, [0037]) and Applicants continually recite "at least the doped ceria being deposited by colloidal spray deposition" (see Applicants' specification page 4, [0015]; page 5, [0024]; and page 6, [0025].) Thus, it is respectfully submitted that the colloidal spray deposition adds structural characteristics to the fuel cell claimed by Applicants not present when other processes are used. Therefore, Applicants submit that the rejection under 35 U.S.C. 103(a) should be withdrawn because the cited references do not teach all of the claim limitations.

Additionally, with regard to claim 1, the Examiner states on page 15 of the March 6, 2003 Office Action that "The combination of the teachings of Mogensen, EP '356, and Wallin as set forth above teach all of the same components as discussed above. Since the components are the same, there is a reasonable expectation of success that the fuel cell described above would effectively operate at an operational temperature from 400-700 °C..."

Applicants submit that the claim limitation "wherein said fuel cell is capable of operating in the temperature range of 400-700 °C" is not merely a "recitation with respect to the manner in which a claimed apparatus is intended to be employed," but rather a requirement that certain structural characteristics exist that allow the fuel cell to operate at temperatures in the range of 400-700 °C. Applicants submit that since neither Morgensen, EP '356, nor Wallin disclose the use of colloidal spray deposition to deposit the anode, there is no reasonable expectation of success that the fuel cell described therein would effectively operate at an operational temperature from 400-700 °C as claimed by Applicants. Since, neither Morgensen, EP '356, nor Wallin disclose a fuel cell operating at temperatures less than 800 °C, it is respectfully submitted that the references cited by the Examiner do not teach all the claim limitations of claim 1.

It is respectfully submitted that claim 1 and claim 12 are allowable over the cited references. Since claims 2-3, and 6-9 ultimately depend on claim 1 and since claims 13-17 ultimately depend on claim 12, Applicants respectfully suggest that these claims are also allowable over the cited references.

Claims 4 and 5 were rejected under 35 U.S.C. 103(a) as being unpatentable over Mogensen in view of EP '356 and Wallin as applied to claims 1-3, 6-9 and 12-17 above, and further in view of either U.S. patent No. 6,458,170 (Visco) or U.S. patent No. 5,306,411 (Mazanec). Claim 5 has been cancelled. It is respectfully submitted that claim 1 is allowable over the cited references. Since claim 4 ultimately depends on claim 1, Applicants respectfully suggest that this claim is also allowable over the cited references.

Claims 18-20 were rejected under 35 U.S.C. 103(a) as being unpatentable over Mogensen in view of EP '356 and Wallin as applied to claims 1-3, 6-9 and 12-17 above, and further in view of U.S. patent No. 5,672,437 (Yajima). It is respectfully submitted that claim 12 is allowable over the cited references. Since claims 18-20 ultimately depend on claim 12, Applicants respectfully suggest that these claims are also allowable over the cited references.

Claim 11 was rejected under 35 U.S.C. 103(a) as being unpatentable over Mogensen in view of EP '356 and Wallin as applied to claims 1-3, 6-9 and 12-17 above, and further in view of either U.S. patent No. 5,932,146 (Kuo) and Weber et al. "Electronic, Ionic and Mixed Type Conductors in SOFC" (Weber). It is respectfully submitted that claim 1 is allowable over the cited references. Since claim 11 ultimately depends on claim 1, Applicants respectfully suggest that this claim is also allowable over the cited references.

Conclusion

In the unlikely event that the Patent Office determines that an extension and/or other relief is required as a result of this statement, Applicants petition for any required relief including extensions of time and authorize the Assistant Commissioner to charge the cost of such petitions and/or other fees due to our Deposit account no. 12-0695. However, the Assistant Commissioner is not authorized to charge the cost of the issue fee to the Deposit Account.

Respectfully submitted,

Dated: August 21, 2003 By: _____

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